1. HEAT

- **Heat :** Heat is the form of energy which flows between two objects or systems as a result of temperature difference between them. Heat is also called **thermal energy**.
  - **Units of heat :** Its S.I. unit is Joule (J). Other commonly used unit is Calorie (cal).
  - **Calorie** is the amount of heat required to raise the temperature of 1 gram of water by 1°C.
    1 Calorie = 4.18 J ≈ 4.2 J
    1 kilocalorie (kcal) = 1000 calories = 4180 J
    1 kilojoule (kJ) = 1000 J
    1 megajoule (MJ) = 10^6 J
  - Heat naturally flows from high temperature to low temperature.
  - If heat can flow between two objects or systems, the objects or systems are said to be in **thermal contact**.
- **Temperature :** The measure of degree of hotness or coldness of a body is called its temperature.
  - Energy must be either added to or removed from a substance to change its temperature.
  - **Thermal equilibrium :** It is a state in which two bodies acquire identical temperatures when they are in physical contact with each other.
  - **Thermometry :** The branch of physics that deals with the measurement of temperature, temperature scales and temperature measuring devices is called **thermometry**.
  - **Thermometer :** It is an instrument used for measuring the temperature of a substance.
  - **Types of thermometers**
    - **Liquid thermometer :** It works on the principle of change in the volume of a liquid with the change in temperature. The temperature range for a mercury thermometer is – 37 °C to 356 °C but the range can be increased to 550 °C by filling nitrogen in the space over mercury column under high pressure. Temperature range for alcohol thermometer is – 200 °C to 78 °C.
    - Some other thermometers are (a) Bimetallic thermometers (b) Thermocouple thermometers (c) Pyrometers.
- **Temperature scales**
  - **Fahrenheit scale (°F)**
    - **Gabriel Fahrenheit** (1686–1736), a physicist, invented the alcohol thermometer in 1709 and the mercury thermometer in 1714.
    - The upper and lower fixed points of Fahrenheit scale are 212 °F and 32 °F.
  - **Centigrade scale (°C) or Celsius scale**
    - **Anders Celsius** (1701–1744), an astronomer, devised the centigrade scale of temperature in 1742.
    - The upper and lower fixed points of Centigrade scale are 100 °C and 0 °C.
  - **Kelvin Scale (K)**
    - **Lord Kelvin (Sir William Thomson)** (1824–1907), a mathematician and a physicist, developed the absolute temperature scale (now named the Kelvin scale).
    - The upper and lower fixed points of Kelvin scale are 373 K and 273 K.
    - **Absolute zero** is the lowest temperature possible in the universe. At absolute zero, there is no heat and the motion of particles (atoms or molecules) ceases (stops).
    - Absolute zero occurs at – 273 °C or – 459 °F.
    - A temperature in Celsius measures only relative thermal energy, relative to zero Celsius. The Kelvin temperature scale is useful in science because it starts at absolute zero, the minimum possible temperature. A temperature in Kelvin measures the actual energy of atoms relative to zero energy.
    - Kelvin Scale is also called '**thermodynamic scale**' or '**absolute temperature scale**'.

$$\frac{T-L.F.P}{U.F.P-L.F.P}=\frac{C-0}{100-0}=\frac{F-32}{212-32}=\frac{K-273}{373-273} \text{ or } \frac{C-0}{100}=\frac{F-32}{180}=\frac{K-273}{100}$$

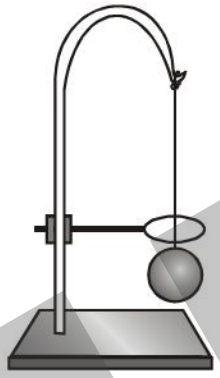
Where, T is temperature of any scale, L.F.P is lower fixed point, U.F.P is upper fixed point.

- Also, $\boxed{\frac{C}{5}=\frac{F-32}{9}=\frac{K-273}{5}}$

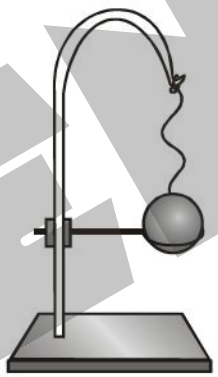
■ **Thermal expansion :** Increasing the temperature of a substance causes the volume of the substance to increase. This phenomenon is known as **thermal expansion**.

- Matter expands on heating and contracts on cooling. As we know that in every object, the particles are in the state of constant motion. The speed of these particles increases as the temperature of the object increases. As the particles move faster, and the distance between particles increases. The increased separation between the particles results in the expansion of the object and the size of the object increases. When a material cools, the particles in the material move more slowly and become closer together. As a result, the material contracts and its size decreases.
- **Thermal expansion of solids :** Solids expand on heating but their expansion is quite small as compared to liquids or gases. This is because the attractive forces between the particles of the solids are quite strong as compared to liquids or gases. Also, different solids expand by different amounts for the same increase in temperature.

  Expansion in solids can be demonstrated by ball and ring experiment. When both the ball and the ring are at room temperature, the ball easily passes through the ring as shown in figure (a) but when the ball is heated, it does not go through the ring as shown in figure (b). If the ball is again cooled to room temperature, it will pass through the ring again as the ball contracts to its original size.



(a) At room temperature, the metal ball passes through the ring easily.

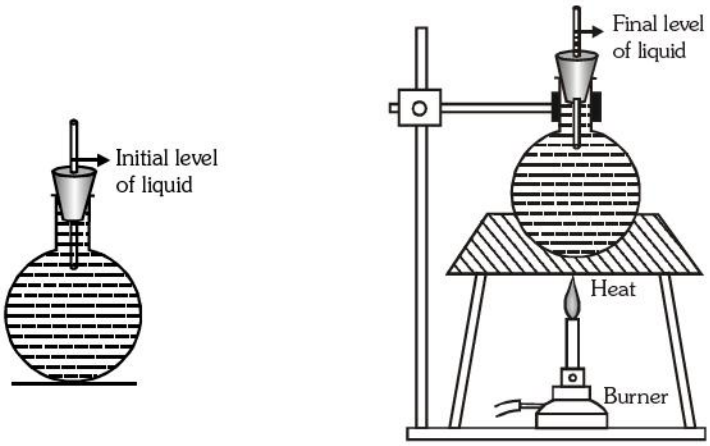


(b) At high temperature, the metal ball cannot pass through the ring.

- **Thermal expansion of liquids :** The attractive forces between the particles in liquids are usually weaker than the forces between the particles in a solid. As a result, the same temperature increase usually causes liquids to expand much more than solids. For example, the liquid in the thermometer expands as its temperature increases. However, the size of the glass tube containing the liquid hardly changes at all.
- **Thermal expansion of gases** : In a gas, the attractive forces between particles are much weaker than they are in liquids. As a result, gases expand even more than liquids for the same increase in temperature.

Expansion joint on a bridge

Hot air balloon : The air inside the hot-air balloon expands as it is heated. Its density decreases and the balloon rises.

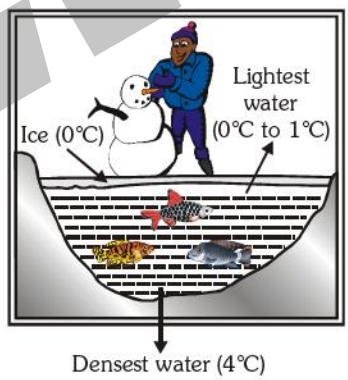


Expansion of liquid on heating

- **Change in the density of a material on changing temperature :** When a material is heated, thermal expansion occurs, the volume of the material increases. Because the material's volume has increased, but its mass hasn't changed, the density of the material decreases. Similarly, on cooling, the material contracts i.e., volume of material decreases, thus, the density of material increases.

■ **The unusual behaviour of water :** Liquids generally increase in volume with increasing temperature and have average coefficients of volume expansion about ten times greater than those of solids. Water is an exception to this rule.

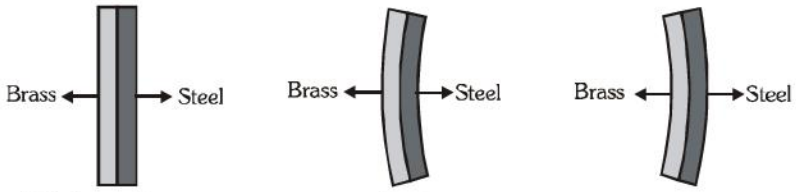
- As the temperature increases from 0°C to 4°C, water contracts and thus its density increases.
- Above 4°C, water expands with increasing temperature, and so its density decreases.
- The density of water reaches a maximum value of 1000 kg/m^3 at 4°C.
- Due to this, water in a pond begins freezing at the surface rather than at the bottom. When the atmospheric temperature drops from, say, 7°C to 6°C, the surface water also cools and consequently decreases in volume. The surface water is denser than the water below it, which has not cooled. As a result, the surface water sinks, and warmer water from below is forced to the surface to be cooled. When the atmospheric temperature is between 4°C and 0°C, however, the surface water expands as it cools, becoming less dense than the water below it. The mixing process stops, and eventually the surface water freezes. As the water freezes, the ice remains on the surface because ice is less dense than water.



The ice continues to build up at the surface, while water near the bottom remains at 4°C. If this were not the case, then fish and other forms of marine life would not survive.

■ **Applications of thermal expansion**

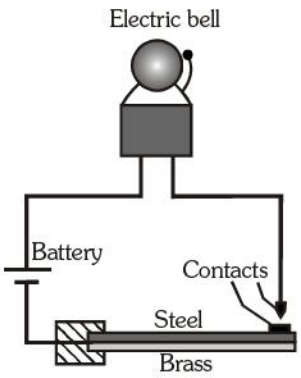
- **Bimetallic strip :** When two strips of same length made of different metals are joined together and then heated, one expands more than the other. This is called '**differential (unequal) expansion**'. The joined strips when heated (or cooled) bend into a curve, allowing one strip to expand (or contract) more than the other. The bimetallic strip is made by joining a less expanding material (having smaller linear expansion coefficient) such as steel or iron with a more expanding material (having larger linear expansion coefficient) such as brass or copper. Unequal expansions or contractions of the two materials force the bimetallic strip to bend.



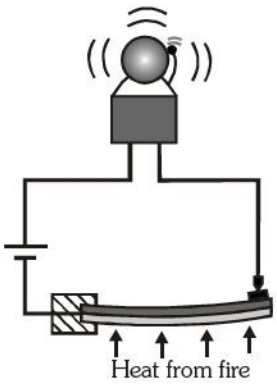
(a) A bimetallic strip at room temperature. (b) A hot bimetallic strip. (c) A cold bimetallic strip.

A bimetallic strip.

- **Thermostat :** It keeps the temperature of a room or a device constant. The bending of the bimetallic strip closes or opens an electrical switch in the thermostat that turns the air conditioner or any other electric device on or off.
- **Fire alarm :** It also utilises bimetallic strip in its working. Heat from the fire makes the bimetallic strip bend and completes the electrical circuit, hence ringing the alarm bell.



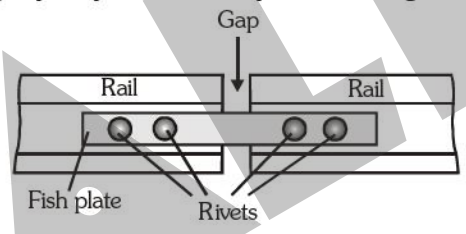
(a) No fire, not heat, bimetallic strip remains straight, circuit is incomplete.



(b) Heat from fire, bimetallic strip bends, circuit is complete, bell starts ringing.

A fire alarm

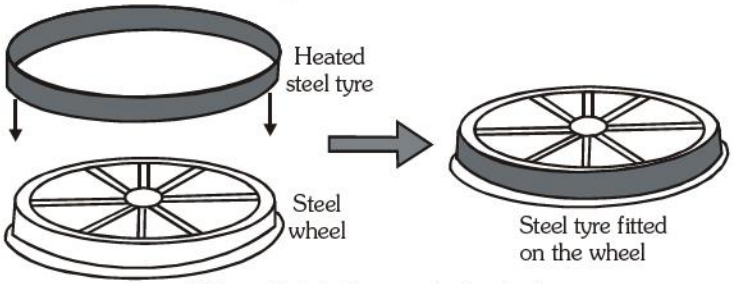
- **Expansion joints in rails :** The railway tracks over which trains run are made of iron. During summer, the iron expands. To allow this expansion, space has to be left between two sections of the rail tracks. If this is not done, expansion of the tracks can cause them to bend. This can cause serious accidents.
- **Roller for expansion or contraction in steel bridges :** Bridges are usually put on rollers so that they can expand and contract without any damage. One end of the steel bridges is made to rest on rollers with enough space provided for expansion during summer.



Expansion joint in rails

Bridges are put on rollers

- **Sagging and tightening of electric cables :** In summer, electric cables between two poles expand and sag. In winter, they contract and get tightened. If cables are fixed in summer, they must be left a little loose to allow for contraction during winter. If this is not done, they may break on contraction in winter. Similarly, in winter they should be fixed tight such that they will sag only a little in summer.
- **Fitting the steel rim on wheels of train :** The steel rim is made smaller than the wheel. The steel rim is heated till its diameter becomes slightly more than the wheel. The rim is then slipped over the wheel. On cooling, the rim contracts and makes a tight fit on the wheel.

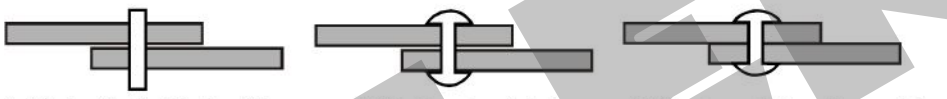


Fitting of steel rim on a train wheel

- **Loops in the metal pipeline :** Pipelines carrying liquids often have loops to allow for expansion and contraction due to temperature changes. Without the loops, the pipes could buckle and burst. During changes in temperature, the loops register only a slight change in their curvature and the overall pipeline is not disturbed.

The large loops let the pipes expand without breaking anything.

- **Riveting :** For joining the two steel plates, they are placed one above the other and holes are drilled in them. The rivets (small cylindrical steel rods) are made hot and inserted in the holes of the plate. The ends of the rivet are hammered into the spherical heads. This can be done easily in heated condition as heating of rivets makes them soft. When the rivets cool, they force plates to come closer and firmly grip them together.



(a) A rivet (cylindrical rod) is inserted in the hole in heated condition to join two plates.

(b) Both ends of rivet is hammered to form spherical heads.

(c) Rivets cool, they force plates to come closer and firmly grip them together.

Joining two plates by riveting.

■ **Calorimetry :** The branch of physics that deals with determination of specific heats, heat absorbed or released during a process, calorific values of combustible substances is called calorimetry.

- **Specific heat (c) :** The amount of heat required for a unit increase in the temperature of unit mass of a substance is called its specific heat.

  Heat absorbed or released by a substance, $\mathbf{Q = m\ c\ \Delta t}$

  where, m = mass of the substance ; c = specific heat of the substance ;

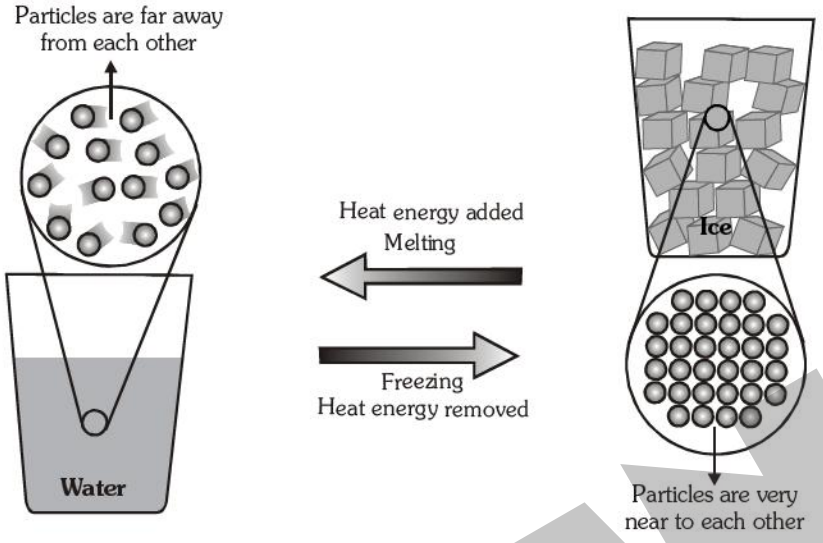
  Δt = change in temperature of the substance.

  - **Unit of specific heat :** J/kg/K or J/kg/°C
  - Specific heat depends on the state of substance i.e., solid, liquid or gas. For example, specific heats of water, ice and steam are different.

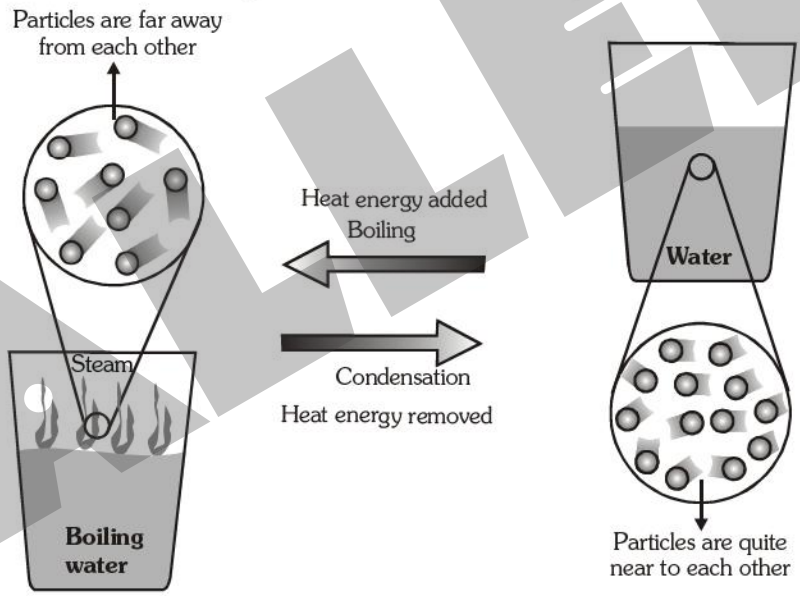
	Cal g^{-1} $°C^{-1}$	J kg^{-1} $°C^{-1}$
Specific heat of ice	0.5	2100
Specific heat of water	1.0	4200
Specific heat of steam	0.47	1970

  - Specific heat signifies the resistance (opposition) of a substance to a change in its temperature.
  - Sand heats up (or cools down) faster than water because the sand on a beach has a lower specific heat than water.
  - The tendency on the part of water to resist changes in temperature improves the climate in many locations.

■ **Change of phase :** A substance changes its phase i.e. from solid to liquid or liquid to gas at constant temperature. A substance changes its state from solid to liquid at its '**melting point**'. Similarly, a substance changes its state from liquid to gas at its '**boiling point**'.



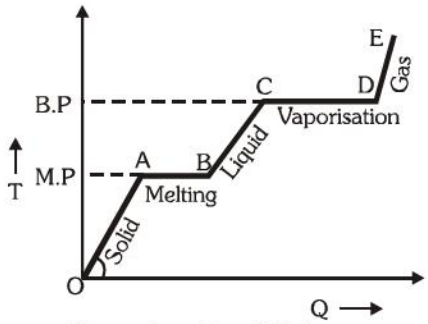
Change of state between solid and liquid.



Change of state between liquid and gas.

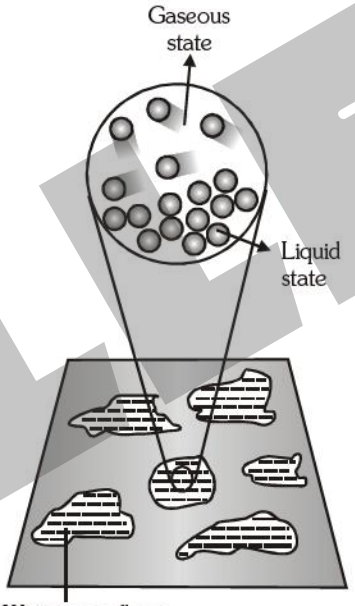
- **Latent heat :** It is the amount of heat absorbed or released per unit mass of a body during the change of state at constant temperature. There are two types of latent heat :
  - **Latent heat of fusion :** The heat per unit mass for the solid-liquid phase change is called the latent heat of fusion. Latent heat of fusion of ice is 80 Cal/g or 3.36×10^5 J/kg.
  - **Latent heat of vaporisation :** The heat per unit mass for the liquid-gas phase change is called the latent heat of vaporisation. The latent heat of vaporisation of water is 540 Cal/g or 2.27×10^6 J/kg.
- **Melting :** Melting occurs when a solid changes into a liquid. The **melting point** of a material is the temperature at which the material changes from a solid to a liquid.
- **Freezing :** Freezing occurs when a liquid changes into a solid. The **freezing point** is the temperature at which the liquid changes to a solid.

- **Vaporisation :** The change from a liquid to a gas is called '**vaporisation**'. Vaporisation can occur within a liquid and at the surface of a liquid. Vaporisation that occurs within a liquid is called '**boiling**'.



Conversion of a solid into vapour

- **Evaporation :**Vaporisation that occurs at the surface of a liquid is called '**evaporation**'. Evaporation occurs during boiling and at temperatures below the boiling point. During evaporation, the fastest particles leave the surface of the liquid. The particles that remain have less speeds. The liquid cools as evaporation occurs. You experience this cooling effect when perspiration evaporates from your skin.



Evaporation occurs only at the surface of a liquid.

- **Condensation :** The change from a gas to a liquid is called '**condensation**'. The **condensation point** is the temperature at which the gas changes to a liquid.

■ **Methods of heat transfer :** Heat transfer can occur in three ways—by conduction, radiation, or convection.

- **Conduction :** The transfer of heat by the direct contact or collision of particles of matter.
  - Conduction usually occurs most easily in solids and liquids, where atoms and molecules are close together. So, atoms and molecules need to move only a short distance before they bump into one another and transfer energy.
  - **Heat conductor :** It is any material that easily transfers heat. Metals are particularly good conductors because their atoms have very mobile (free) electrons that easily transfer the thermal energy that is applied to the metal.
  - **Heat insulator :** It is a material in which heat doesn't flow easily. Liquids and gases are usually better insulators than solids. Wood, plastics, wool, cork, etc. are insulators or poor conductors of heat. E.g. :

(1) In the winter, we use woolen clothes. Wool is a poor conductor of heat i.e., it is a heat insulator. Moreover, there is air trapped in between the wool fibres. Since air is also a heat insulator, it prevents the flow of heat from our body to the cold surroundings. So, we feel warm.

(2) Cooking pans are made of metals while their handles are made of plastics.

(3) A metal block feels colder to the touch than a wooden block, even though the two blocks may have the same temperature. This is because metals conduct heat energy more rapidly than a wooden block.

- **Convection :** The transfer of heat through the motion of matter such as air and water. The circular movement of currents that is set up in liquids and gases is called **convection currents**. Convection can be of two types :

  (i) natural convection (ii) forced convection.

  - **Natural convection :** It is a mode of heat transfer in which the fluid motion is not generated by any external source like a pump or a fan. The heat flows only due to the difference of densities within the fluid that occurs because of the temperature differences in the different regions of the fluid. In natural convection, fluid surrounding a heat source receives heat, becomes less dense and rises. The surrounding, cooler fluid then moves to replace it. This cooler fluid is then heated and the process continues, forming a convection current. Natural convection occurs when a warmer, less dense fluid is pushed away by a cooler, denser fluid. Some examples of natural convection are :

    (1) **Sea breeze :** During the day, the water is cooler than the land. Air above the warm land is heated by conduction. When the air gets hotter, its particles move faster and get farther from each other, making the air less dense. The cooler, denser air from over the lake flows in over the land, pushing the less dense air upward. The cooler air then is heated by the land and also begins to rise. The air from the sea is called the **sea breeze**.

    (2) **Land breeze :** During the night, the water is hotter than the land. Air above the warm water is heated by conduction. When the air gets hotter, its particles move faster and get farther from each other, making the air less dense. The cooler, denser air from over the land flows in over the water, pushing the less dense air upward. The cooler air is then heated by the water and it also begins to rise. The air from the land is called the **land breeze**.

(a) Day time (b) Night time

Sea breeze and land breeze

  - **Forced convection :** It is a mode of heat transfer in which fluid motion is generated by an external source like a pump, fan, blower, etc. It is one of the main methods of transferring heat efficiently. Forced convection is found very commonly in everyday life. It includes following applications :

    (1) Central heating systems.

    (2) Central cooling systems, air conditioning.

    (3) Electric heat convectors or blowers used for room heating at home.

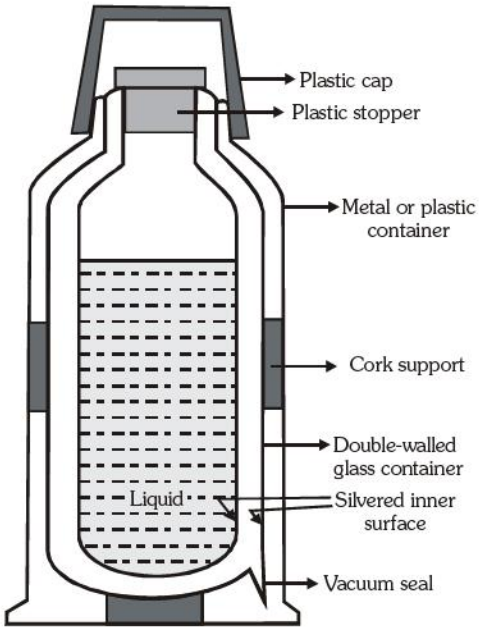
    (4) Heat exchangers used in industries like condensers, heaters, coolers, etc.

    (5) Car, truck or bus engines are cooled by convection current in the water pipes.

- **Radiation :** It is the mode in which no material medium is required.
  - It occurs when energy is transferred in the form of electromagnetic waves.
  - The waves which mainly carry heat from Sun to Earth are infrared rays. These waves are also called **heat waves** or **thermal radiations**. Heat waves are just like light but unlike light, they are invisible. When heat falls on some object, a part of it is reflected, a part is absorbed and a part may be transmitted.
  - It can occur in vacuum, as well as in solids, liquids, and gases.
  - The Sun is not the only source of radiation. All objects emit heat waves, although warm objects emit more radiation than cool objects.
  - Some common examples of radiation are :
    (1) The warmth you feel when you sit next to a fireplace is due to heat transferred by radiation from the fire to your skin.
    (2) When we sit in front of a room heater, we get heat by radiation.
    (3) A hot utensil kept away from the flame cools down as it transfers heat to the surroundings by radiation.
    (4) Our body too, gives heat to the surroundings and receives heat from it by radiation.
  - A silvered mirror surface reflects most thermal radiation, absorbing very little. A good absorber of heat is also a good emitter of heat. This means dark surfaces or black surfaces are good emitters of heat as they are good absorbers of heat. A dull black surface is a better absorber of heat than a shiny black surface. Similarly, a dull black surface is a better emitter of heat than a shiny black surface.
    (1) The outer base of a cooking utensil is painted black so that it absorbs more heat, so that cooking can be done in less time.
    (2) Light coloured clothes reflect most of the heat that falls on them and, therefore, we feel more comfortable wearing them in the summer. Dark surfaces absorb more heat and, therefore, we feel comfortable with dark coloured clothes in the winter.
    (3) The tubes on the back of refrigerators are coloured dull black to radiate (emit) heat more effectively in order to cool down the refrigerator pipes.
    (4) Electric room heaters are provided with a polished metal surface behind the heating element. This surface reflects almost all the radiated heat from the heating element that falls on it and makes the room heater more effective.

■ **Vacuum flask or thermos flask :** A vacuum flask or thermos flask keeps hot things hot or cold things cold for a long time. It is very difficult for heat to travel into or out of the flask.

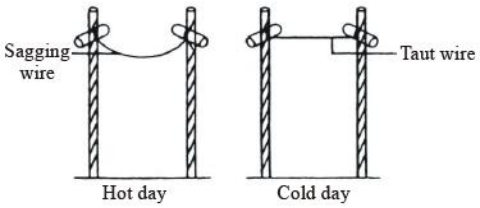
- Transfer by conduction and convection is minimised by making the flask a double walled glass vessel with a vacuum between the walls. This is because both conduction and convection need molecules of a medium for transfer of heat.
- Radiation is reduced by silvering inner surfaces of both the walls. The silvered surfaces reflect the heat back, thus, reducing radiation.
- The slight heat loss that occurs is by conduction up by the glass walls and through the stopper.



A vacuum flask or thermos flask

1. When heat energy is incident on a body, then
(1) it is reflected
(2) it is absorbed
(3) it is transmitted through it
(4) all the above

2. A metal wire was tied between two wooden poles. The given figures show the observations during different weather conditions.



What do you infer from the figures?
(1) The wooden poles expand on hot days
(2) The wooden poles contract on cold days
(3) The metal wire expands on cold days
(4) The metal wire contracts on cold days

3. In a thermos flask, heat loss by conduction and convection can be avoided by
(1) Providing vacuum between the two walls of the flask
(2) Filling the space between the two walls of the flask with cork which is a bad conductor of heat
(3) Providing a shining glass
(4) All the above

4. – 40 °C is numerically equal to
(1) – 40 °F (2) 243 K
(3) – 32 K (4) All the above

5. Absolute zero is the condition at which
(1) molecular motion ceases
(2) gas becomes liquid
(3) matter becomes massless
(4) random motion of molecules occur

6. A hot and a cold body are kept in vacuum separated from each other. Which of the following will cause decrease in temperature of the hot body?
(1) Radiation
(2) Convection
(3) Conduction
(4) Temperature remains unchanged

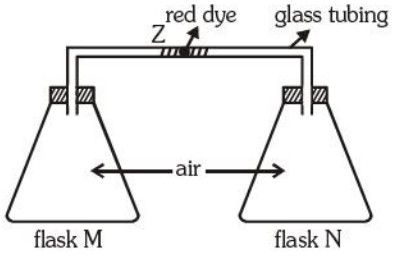
7. If C, F and K are the temperatures on Celsius, Fahrenheit and Kelvin Scale, ΔC, ΔF and ΔK are the change in temperature in Celsius, Fahrenheit and Kelvin scale respectively. The correct relation among the following is
(1) $\frac{C}{5}=\frac{F-32}{9}=\frac{K-273}{5}$
(2) $\frac{\Delta C}{5}=\frac{\Delta F}{9}=\frac{\Delta k}{5}$
(3) $\frac{\Delta C}{5}=\frac{\Delta F-32}{9}=\frac{\Delta K-273}{5}$
(4) $\frac{C}{5}=\frac{F}{9}=\frac{K}{5}$

8. The property of matter to increase in size on heating is called
(1) Thermal work
(2) Thermal energy
(3) Thermal expansion
(4) Thermal contraction

9. The number of divisions between melting point of ice and boiling point of water in fahrenheit scale are
(1) 100 (2) 80 (3) 273 (4) 180

10. In which mode of transfer of heat, molecules pass on heat energy to neighboring molecules without actually moving from their positions?
(1) Conduction (2) Convection
(3) Radiation (4) None of these

11. The diagram shows 2 similar flasks fitted with glass tubings and a drop of red dye is placed at point Z as shown.



What happens to the red dye when the air in flask M is heated?
(1) The red dye will move towards flask N
(2) The red dye will move towards flask M
(3) The red dye will not move in either side
(4) The red dye will disappear

12. A body was supplied 6.00 joules of heat. Express this amount in calories.

(1) 1500 cal (2) 15.00 cal

(3) 1.5 cal (4) 1.43 cal

13. How much heat is required to raise the temperature of 100 g of water from 5°C to 95°C?

(1) 50 kJ (2) 9 kJ

(3) 37.8 kJ (4) 5 kJ

14. 500 g of hot water at 60°C is kept in the open air till its temperature falls to 40°C. Calculate the heat energy lost to the surroundings by the water.

(1) 4.2 J (2) 42000 J

(3) 126000 J (4) 84000 J

15. A sphere, a cube and a thin circular plate, all of same material and same mass are heated at same high temperature, then

(1) Plate will cool fastest and cube the slowest

(2) Sphere will cool fastest and cube the slowest

(3) Plate will cool fastest and sphere the slowest

(4) Cube will cool fastest and plate the slowest

16. How much amount of heat is required to raise the temperature of 100 g of water from 30° C to 100° C? The specific heat of water = 4.2 J g^{-1} $°C^{-1}$.

(1) 25.5 kJ (2) 29.4 kJ (3) 30 kJ (4) 40 kJ

17. When two bodies are in thermal contact, the direction of flow of heat is determined by its

(1) density (2) temperature

(3) heat capacity (4) mass

18. Cooling in a motor car is done by

(1) Conduction (2) Convection

(3) Radiation (4) All the above

19. Choose the correct statement :

(A) Boiling of a given substance takes place at all temperatures.

(B) Evaporation of a substance takes place at a constant temperature

(C) Boiling takes place at every part of the liquid

(D) Evaporation takes place only on the surface of liquid

(1) Both A and C (2) B, C and D

(3) Both C and D (4) All the above

20. As compared to the person with white skin, the person with black skin will experience

(1) less heat and more cold

(2) more heat and more cold

(3) more heat and less cold

(4) less heat and less cold

21. In case of an incense stick or an agarbatti, the smoke at the lighted end of stick moves in upward direction, because

(1) The cool air below the lighted end moves to take the place of hot air above the lighted end.

(2) The air at the hot end is more dense

(3) It is natural for the smoke to move up

(4) The smoke is repelled by the gravity of earth

22. An iron ball at 40°C is dropped in a mug containing oil at 40°C. Then

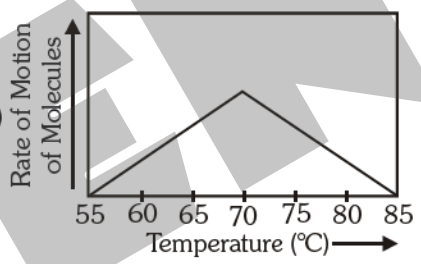
(1) heat flows from iron ball to oil

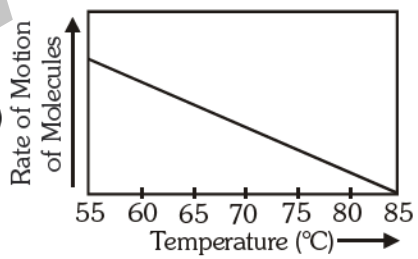
(2) heat flows from oil to iron ball

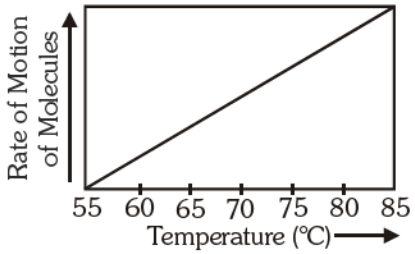
(3) heat does not flow between oil and iron

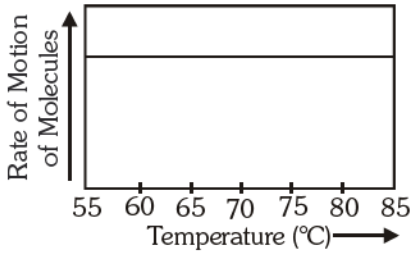
(4) None of these

23. Which graph correctly shows the effect of temperature on the motion of molecules of matter?

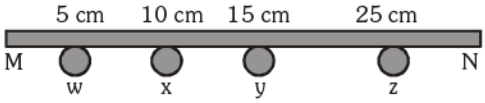
(1)


(2)


(3)


(4)


Direction : (Q.24 & 25) : Look at the diagram carefully and answer the given questions.



Given above is a metal rod of length 50 cm. 4 drops of wax, w, x, y and z are placed at the distance of 5 cm, 10 cm, 15 cm and 25 cm respectively from the end M.

24. When heated from the end M, drop w comes off first in 2 minutes time. What will be the time taken for the drops x, y and z to fall?

(1) x → 1 minute, y → 2 minute, z → 3 minute

(2) x → 2 minute, y → 4 minute, z → 6 minute

(3) x → 2 minute, y → 2 minute, z → 2 minute

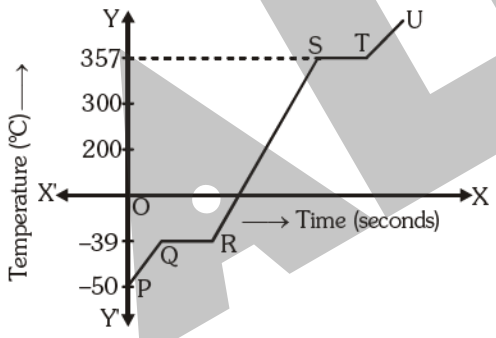
(4) x → 4 minute, y → 6 minute, z → 10 minute

25. When heated from end N, what will be the time taken for the drop z to come out?

(1) 8 minutes (2) 12 minutes

(3) 10 minutes (4) 5 minutes

Direction (Q.26 to 28) : The heating curve of a particular substance in solid state is as shown in the figure : Choose the correct alternative.



26. The boiling point of the substance is ____ °C.

(1) – 39

(2) 300

(3) 357

(4) Cannot be determined

27. The portion QR of the graph indicates

(1) No change in heat energy

(2) Change in temperature

(3) Change of state

(4) Both (2) and (3)

28. RS part of the graph indicates _____ state of substance.

(1) Solid

(2) Liquid

(3) Gaseous

(4) Cannot be determined

29. Arrange the following steps in sequential order to show that the conduction of heat is different in different conductors.

(a) Take two identical rods one is copper and the other is iron

(b) The ends of the two rods are heated with the same spirit-lamp

(c) Fix some nails on the rods with the help of wax at equal distances

(d) The nails near to the flame falls first from the copper rod and then from the iron rod.

(1) acdb (2) abcd (3) acbd (4) adbc

30. At what temperature on the Fahrenheit scale is the reading five times the reading on the Celsius scale?

(1) 20°F (2) 25°F (3) 50°F (4) 100°F

31. For a certain engineering application, it is required to raise the temperature of a given mass of a body as quickly as possible. The material should have

(1) high specific heat capacity

(2) high density

(3) low specific heat capacity

(4) heat capacity

32. If the temperature of a body rises by 1 K, the corresponding change of reading on Celsius scale is

(1) 1.2°C (2) 2.73°C

(3) 1°C (4) 2.7315°C

33. The numerical value at which the Fahrenheit and Kelvin scale coincides is

(1) 474.6 (2) 574.6 (3) 674.6 (4) 774.6

34. A Thermometer reads the temperature of a body as 55°C, its reading in °F and K will be

(1) 328°F & 132 K (2) 131°F and 328 K

(3) 225°F and 113 K (4) 113°F and 225 K

35. The range of clinical thermometer is

(1) 95°C to 105°C (2) 92°C to 102°C

(3) 94°F to 105°F (4) 90°F to 122°F

36. The temperature of a body is raised by 40°C, the corresponding increase in Fahrenheit scale is

(1) 40°F (2) 42°F (3) 104°F (4) 72°F

37. A thermometer reads 50° on a cold January day in New Delhi. The reading is on scale

(1) Fahrenheit (2) Kelvin

(3) Absolute (4) Celsius

38. The freezer in a refrigerator is fitted near the top

(1) To keep it away from the hot compressor which is near the bottom

(2) Because of convenience

(3) So that it can cool the whole interior by setting up convection currents

(4) All the above

39. Which of the following is true? The density of water

(1) is maximum at 4°C

(2) is minimum at 4°C

(3) decreases as the temperature is increased

(4) increases with temperature

40. Two solid objects -1 and 2 are lying in a room for many days. The conditions surrounding both the objects were the same. Raju touched object 1 with his left hand and it felt cold to the touch. Then he touched object 2 with his right hand and felt warm to the touch.

If object 1 comes in contact with object 2, will there be heat transfer?

(1) Yes, heat will be transferred from object 1 to object 2

(2) Yes, heat will be transferred from object 2 to object 1

(3) No, there will be no heat transfer between the objects

(4) We cannot say based on the given information.

41. When a substance is heated, its

(1) molecules move more slowly

(2) molecules move more rapidly

(3) there is no change in the speed of its molecules

(4) its temperature always decreases

42. When water is filled in a bottle and is allowed to freeze, the bottle breaks because

(1) water expands on freezing

(2) bottle contracts on freezing

(3) temperature outside the bottle is less than inside the bottle

(4) None of these

43. Statement-1 : The melting point of pure ice at normal atmospheric pressure is taken as lower fixed point.

Statement-2 : One calorie is the quantity of heat energy required to raise the temperature of 1g of water through 1°C.

(1) Both statements 1 and 2 are correct

(2) Both statements 1 and 2 are incorrect

(3) Statement-1 is correct but statement 2 is incorrect

(4) Statement-1 is incorrect but statement 2 is correct

44.

Column-I		Column-II	
(A)	SI unit of Temperature	(p)	Thermometric liquid
(B)	Heat	(q)	Kelvin
(C)	Thermometer	(r)	Calorie
(D)	Mercury	(s)	Device for measuring the temperature
		(t)	Fahrenheit

(1) (A)-q ; (B)-r ; (C)-s ; (D)-p

(2) (A)-t ; (B)-r ; (C)-p ; (D)-q

(3) (A)-s ; (B)-p ; (C)-q ; (D)-r

(4) (A)-r ; (B)-q ; (C)-p ; (D)-s

45. The process in which lighter nuclei combine to form a heavier nucleus along with liberation of energy is

(1) Nuclear fission (2) Nuclear fusion

(3) Both (1) and (2) (4) Neither (1) nor (2)

46. Choose the incorrect option

(1) Temperature is a vector quantity

(2) Heat energy is also called thermal energy

(3) The device for measuring the temperature of a substance is called a thermometer

(4) Temperature of a body decides the direction of heat flow from the body

47. A brass ring is tightly fitted over an iron cylinder. To loosen the ring, the system must be

(1) heated

(2) cooled

(3) at first heated then cooled

(4) none of these

48. While lying a railway line, a small gap is left in between the two rails at their joints to allow
(1) expansion during summer
(2) contraction during winter
(3) both (1) and (2)
(4) none of these

49.

Column-I		Column-II	
(A)	The glass tumbler cracks when very hot liquid is poured	(p)	To allow the expansion of rails in summer
(B)	The pendulum clock loses time in summer	(q)	Due to unequal expansion
(C)	Rail tracks are layed with gaps	(r)	To allow the contraction in winter
(D)	A little sag is left while lying telephone wires	(s)	Due to the increase in effective length of the pendulum

(1) (A)-p ; (B)-q ; (C)-s ; (D)-r
(2) (A)-s ; (B)-r ; (C)-p ; (D)-q
(3) (A)-s ; (B)-p ; (C)-q ; (D)-r
(4) (A)-q ; (B)-s ; (C)-p ; (D)-r

50. Bimetallic strip works on the principle of _____
(1) differential expansion
(2) similar expansion
(3) unequal expansion
(4) both (1) and (3)

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	4	4	4	1	1	1	1	3	4	1	1	4	3	2	3	2	2	4	3	2
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	1	3	3	4	3	3	3	2	3	3	3	3	2	2	3	4	1	3	1	2
Que.	41	42	43	44	45	46	47	48	49	50										
Ans.	2	1	1	1	2	1	3	3	4	4										